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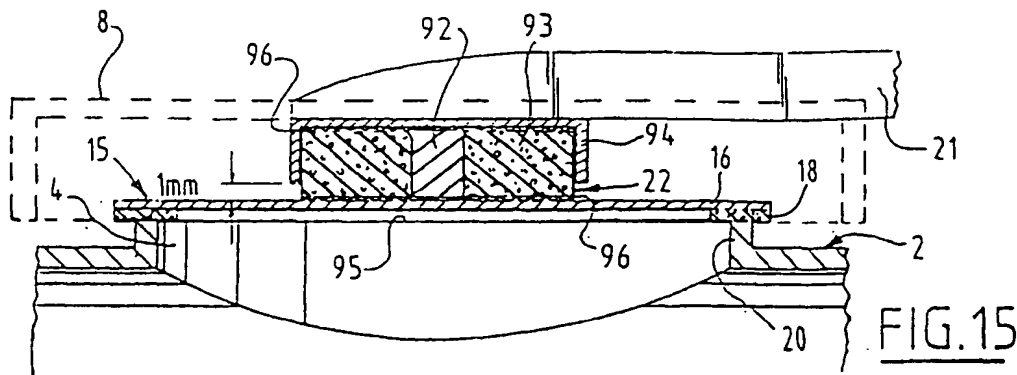
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(54) Wind instrument and closure member for a wind instrument

(57) The invention relates to a wind instrument comprising a basic body in which extends a central duct bounded by a peripheral wall of the basic body, a plurality of openings in the peripheral wall which connect the duct with the surrounding air, a number of valves mounted on the basic body and each comprising a closure member (5) coacting with an opening and comprising control means (49,52) connected to said valves, wherein said control means guide said closure member for movement between a closed position in which the opening is closed by said closure member and an open position in which the opening is left clear, wherein the

closure member comprises a plate (16) of substantially stiff material which is provided on the side facing toward the opening with sealing material (18) and in the closed position engages round the opening and that the closure member is connected to the control means by yieldable means (52) and wherein the plate of substantially stiff material is connected to a rod (54) of said control means by means of an engagement element (49) fixedly mounted on the rod or forming part of said rod. Said engagement element extends from the centre of the plate in diverse directions over only a fraction of the radius of the plate.



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Description

[0001] The invention relates to a wind instrument, such as a saxophone, clarinet, flute, bassoon, oboe or like instrument provided with closure members.

[0002] Such a wind instrument comprises a basic body in which extends at least one central duct which is bounded by a peripheral wall of the basic body. Formed in the peripheral wall is a number of holes which connect the duct with the surrounding air. At least a number of these openings can be opened and closed by means of closure members mounted on the instrument.

[0003] The invention improves a wind instrument according to the preamble of claim 1. The kind disclosed in US-A-3,501,991 is improved.

[0004] The wind instrument according to the invention described in claim 1 requires less material and has a lower weight. As the moving mass of the closure member is reduced the closing operation makes less disturbing noise. The musician can operate the closure members easier and/or with greater velocity.

[0005] FR-A-1034063 proposes to do not connect the valve holder fixedly to the arm of the control means, but to connect it by means of pivot means. These pivot means do not comprise yieldable means, but permit the valve holder to tilt freely, so freely that it may approach the opening in a position which is far from adapted to its required closed position, resulting in an instrument which does not play satisfactorily.

[0006] According to the invention the yieldable means hold the substantially stiff plate almost in its position, which is required for the closing position. During the closing operation its position is yieldably a little corrected to realise a well closing position.

[0007] The invention also relates to and provides a closure member as claimed in claim 10.

[0008] The invention will be further elucidated in the following description with reference to the accompanying drawings, wherein

Figure 1 shows a perspective view of a saxophone; Figure 2 shows a detailed view of a closure member of the saxophone of figure 1 as according to arrow II; Figures 3, 5, 7, 9, 10, 12 and 14-16 show a cross section of the closure member according to the invention.

Figure 4 is a perspective view of a fraction of the instrument of figure 1; and

Figures 6, 8 and 13 each show a fraction of the top view of figures 5, 7 and 12 respectively.

[0009] In figures 1, 2 and 4 the engagement element 8 is not formed according to the present invention.

[0010] In the figure description functionally identical elements have the same numerals.

[0011] The saxophone 1 shown in figure 1 comprises a basic body or hull 2 of metal, for instance brass, through which extends a duct. A hull of wood, hard plas-

tic or compound material, such as ground hardwood with epoxy resin, is also possible in particular instruments.

[0012] The duct extends from the mouthpiece 3 to the opening 4 on the front end of basic body 2.

[0013] In the peripheral wall of basic body 2 is formed a plurality of openings which can be closed or opened by valves 5.

[0014] The valves 5 comprise closure members which are movable by control means 6 between an opened position at a distance from the associated opening 4 and a closed position wherein the opening 4 is closed by the closure member 15. The valves 5 are controlled by hand in order to create a desired pitch.

[0015] Figure 2 shows the principle of a valve 5 of the saxophone 1. In this embodiment the valve 5 comprises a cup-shaped cover 8 receiving a closure member 15 to be described further. The cover 8 is connected to a rod 21 which is pivotally connected at 10 to a support 11 fixedly connected to basic body 2. On the opposite end the rod 21 is provided with a key 9. On rod 21 is arranged a leaf spring 12 which, in this example, urges rod 21 in counterclockwise direction, i.e. urges the cover 8 onto opening 4. The cover 8 with closure member 15 received therein can thus be moved away from opening 4 by pressing the key 9. The opened position of valve 5 is determined by a stop element 13 which is usually made of cork.

[0016] According to figure 3 the cover 8 (of figures 1 and 2) is omitted and the closure member 15 is directly connected to the rod 21 of control means 6. The mass of the control means 6 hereby becomes smaller, which can contribute to a lighter operation of the valve mechanism.

[0017] The actual closure member 15 comprises a substantially stiff plate 16, in any case a plate of hard material, which is provided with sealing material 17 on the side facing toward the opening 4. In this embodiment the sealing material consists of a ring 18 either of foam material, such as a thin layer of cellular rubber with a thickness in the order of magnitude of 0.5 to 2 mm, preferably between 0.5 and 1.5 mm and in particular between 0.7 and 1.2 mm, which layer is optionally covered with a thin layer of supple leather 19, or of very soft solid rubber which is for instance vulcanized to plate 16, said ring being connected directly to the stiff plate 16. The edge 20 around the opening 4 is usually made flat so that the surface of the sealing material can make good sealing engagement on this edge. The leather layer 19 is preferably not used and the thin layer of cellular rubber consists of cellular rubber with very small closed cells. The average cell diameter is smaller than 0.5 mm, for instance smaller than 0.3 mm and preferably smaller than 0.2 mm. This sealing material is for instance coated on the outside with a sealing film to prevent infiltration of moisture. In small valves, for instance of a clarinet, the said ring 18 is for instance replaced by a round disc of the same material.

[0018] The hard plate 16 is preferably a metal plate made flat so that it extends accurately at a constant distance from the edge 20 and the sealing surface is thus supported accurately in one and the same surface. The plate 16 has a rigidity, depending on the selected metal type and the diameter of the tone opening, such that the deflection of the plate resulting from strong playing force (approximately 2N) is preferably smaller than 0.3 mm, more preferably smaller than 0.2 mm, for instance in the order of magnitude of 0.1 mm. In the case of stainless steel (stainless steel 430) the plate thicknesses are 0.1 tot 1 mm, preferably 0.15 -0.8 mm, most preferably in the order of magnitude of 0.5 mm.

[0019] The closure member 15 is yieldably connected to the control means 6. This yieldable connection is realized in that a male part 23 of a hard rubber press fastener is glued into the cover 8 with interposing of a foam resin pad 22, preferably with a thickness in the order of magnitude of 2 mm. The stiff plate 15 is pushed over this male part 23 of the press fastener and the female part 24 (of hard rubber or plastic) of the press fastener is subsequently snapped onto the part protruding through the plate 16. The foam material 22 constitutes yieldable means with which the closure member 15 is connected for slight movement to the control means 6. In terms of its position, the closure member 15 and particularly the sealing ring thereof can adapt precisely to the edge 20 and make all-round close sealing engagement therewith, even if in the not yet fully closed position the closure member 15 were to lie in slightly inclining position relative to the edge 20. Due to the pressure force of the spring 12 or, in the opposite case, due to the pressure force exerted by hand, the closure member 15 comes to lie precisely on the edge 20. Due to these yieldable means in the form of the layer of foam material 22, the valves 5, mutually connected for instance as according to figure 4, are easily adjustable relative to each other. With little adjustability the simultaneous good closure can be realized with little pressure force. In figure 4 for instance the valve 5B is also closed each time that each or any of a series of valves 5A is closed. For this purpose the rod 21B which is urged to the open position by a spring 12B is fixedly connected to a longitudinal rod 38, which supports via a cork 41A on the rods 21A which themselves support in the open valve position on the body 2 via a cork 42A. If at least one of the valves 5A is closed by means of the finger key 43 soldered thereon, the closure members 15B and 15A will simultaneously close properly, because both closure members 15B and 15A connect to the control means 6 via the yieldable means.

[0020] Assembly of the closure members 15 using the snap connection, particularly formed by a press fastener, enables a very simple replacement of the closure member 15. However, it falls within the scope of the invention to fix the closure members 15 to the control means respectively in the cover 8 with for instance a piece of double-sided foam adhesive tape.

[0021] The valve 15 of figures 5 and 6 does not have the cover 8. A brass bush 50 is soldered to rod 21 and has a threaded hole 51 into which is screwed a screwed rod 52 with a grooved head 53 for a screwdriver and a lower piece 55 comprising a threaded hole 54. A stiff, concave or flat plate 16 of 0.4 mm brass is screwed into the threaded hole 54 by means of a screw 56 with a stop edge 57 with interposing of an elastic rubber block 49. Soldered to the plate 16 is an ornamental disc 58 of thin brass and a central opening 59 thereof is optionally covered with a soldered brass ring 60. A small play K of for instance 1 or 2 mm is left free between bush 50 and ring 60. Due to the yieldable means formed by the elastic rubber block this closure member 15 can yield slightly after closing of the valve 5 during a small continuing downward movement of bush 50. This closure member 15 is easily adjustable when the counter-nut 61 is released.

[0022] The valve 5 of figures 7 and 8 has a brass bush 62 welded to a rod 21, in which bush a hard rubber base plate 45 is glued, optionally with interposing of a hard filling piece 44. A concave, stiff brass plate 16 encloses a rubber block 49 and is itself enclosed by a soft ring and a female part 24 of a press fastener.

[0023] In all figures the yieldable means 6, for instance consisting of a layer 22 or 32 or a block 49, allow a small stroke of the closure member 15 at a normal finger keying force during playing of the instrument such that the good sealing closure of each valve 5 of a plurality of simultaneously closing valves 5 is obtained when there is sufficient stiffness of the valve control. Too soft an elasticity is disastrous. While playing the instrument the musician must retain the feeling of a direct touch. The stroke permitted by the yieldable means 6 is preferably less than 3 mm and more preferably less than 1 mm. A stroke in the order of magnitude of 0.5 mm is ideal. The more a sensitive, for instance professional musician appreciates the perfect feeling of contact with the instrument the smaller the stroke is chosen, for instance 0.2-0.4 mm, since in such a case somewhat longer adjustment work and related higher costs are less important. However, the adjustment of a known instrument intended for professional use requires much more time.

[0024] In the case the, particularly professional, musician appreciates the absolute reliability of the perfect closure of the valve 5, he will prefer a slightly longer stroke, for instance 0.4-0.7 mm.

[0025] For amateurs who prefer preventing possible valve correction, a stroke in the order of magnitude of 1 mm and more is preferable.

[0026] Understood by the said finger force is a playing finger keying force, i.e. a kinetic energy corresponding with a static force lying between 0.25 and 5 N, particularly between 0.25 and 3 N and preferably smaller than 1 N.

[0027] Figure 9 shows on a scale of 6:1 a convex closure member 15 consisting of a metal, for instance tom-

bac, stiff plate with a sealing ring 18 of cellular rubber, which closure member 15 adapts if necessary to the edge 20 by swiveling slightly in that it is received for slight swiveling in a solid rubber ring 71 with U-shaped profile and having a hardness between 40° and 80° Shore.

[0028] The valve holder 8, indicated with dashed lines, which is used in known wind instruments is omitted and to an arm 21 of the valve control mechanism is soldered a bold head 72 and therearound a tombac ring 73. Around the bolt stem a ring of cellular rubber is arranged between two rings 73 which, together with the ring 71 and the closure member 15 contained therein, are clamped together by means of nut 75 screwed onto the bolt stem 74. The wind instrument of which all closure members 15, irrespective of their diameter, are practically all provided with identically dimensioned connecting means 71-75 and which have sealing rings 18 with a thickness of 0.5-1 mm and a width of $\pm 3-8$ mm, has a beautiful sound and requires hardly any adjustment after assembly. The sealing is ensured, the instrument plays smoothly, easily and clearly.

[0029] Figure 10 is identical to figure 9, with the difference that a rubber hose 77 is arranged round the bolt stem 74 and the closure member 15 is further enclosed by means of a ring 78 of soft, practically solid rubber with a hardness in the order of magnitude of 0-50° Shore.

[0030] According to figure 11 the closure member 15 is fixed to the arm 21 in that the bolt shaft 74 with bolt head 72 and ring 73 together with a U-shaped brace 80 form a mutually soldered unit 81, to which the closure member 15 according to figures 18 and 19 is fixed. This unit 81 is placed on the arm 21 as according to arrow 82 and clamped thereon by means of screw 83.

[0031] In figures 12 and 13 the closure member 15 is fixed to a round disc-shaped end 84 of arm 21 by means of a nut 75, a practically solid rubber ring 71, a metal ring 73 and a cellular rubber ring 32 and by means of a bolt stem end 85 soldered in said end 84.

[0032] Figure 14 is identical to figure 12, with the difference that the closure member 15 with its practically solid rubber ring of for instance 40° Shore is clamped directly against the disc 84. If the ring 71 fits closely round the bolt stem 74 the nut 75 may optionally be omitted.

[0033] In figures 9-15 the components are shown with their preferred dimensioning. Reference is made to said indicated dimensions. Dimensions in the same order of magnitude are preferably applied. The diameters and the rings 18 of the various closure members 15 are of course adapted to the openings 4 of the basic body 2. Identical elements are otherwise used for the connections.

[0034] Because the closure members 15 seal so well, the valve springs of closed valves can be adjusted with less tension.

[0035] The edges 20 of the openings 4 are each prop-

erly ground flat in one and the same plane.

[0036] In figure 15 a completely flat, thin metal plate 16, for instance of titanium with a thickness of for instance 0.2-0.5 mm, preferably of this order of magnitude, fits on the flat edge 20 with interposing of the thin sealing ring 18 of cellular rubber with closed cell structure of for instance a thickness of 0.5-2 mm, preferably of this order of magnitude. A plate 16 of plastic or other form-retaining, albeit elastic, material can also be envisaged. The plate 16 is adhered centrally to the rod 21 with interposing of yieldable means 22, which in figure 29 consist of a soft rubber core 92 (hardness 40-80° Shore) with a diameter of 2-7 mm and a height of 1-5 mm, which is surrounded by a ring 93 of cellular rubber with a diameter of 4-12 mm and a thickness of 1-5 mm. Ring 93 is glued on both sides between the plate 16 and a bush 94 which is soldered to a rod 21 without cover 8 or glued between the plate 16 and a cover 8 normally integrated with the rod 21. The ring 93 serves to increase the adhesion surface of the layers of glue 96 without preventing the required swivel possibility of plate 16. The core 92 is loosely enclosed between bush 94 and plate 16 or is glued to only one side, and can be conical or have another shape.

[0037] The plate 16 is preferably completely flat, but can however be permanently concave or convex under the influence of the closing force. The yieldable means 22 can also take the form of the elements 49 of figure 12, preferably having a thin middle portion.

[0038] All given dimensions and values serve as example and indication of the order of magnitude. The springs which tension the control means are adapted to the necessary compressions for closing the valves, i.e. tensioned considerably less than usual. The instrument according to the invention hereby plays very lightly. It is less tiring and it is possible to play faster and better. The tension of the springs of valves closed in rest position is preferably low such that as a result of hard blowing these valves are only just not blown open by the then occurring air pressure; the tension of the springs of valves opened in rest position is preferably low such that these valves move up and downward with just enough speed to follow the fingers during fast playing. The spring tensions are herein chosen slightly higher for safety reasons.

[0039] In figure 15 the displacement of the valve 15 in radial direction is prevented by the edge of the bush 94 which extends up to a small distance of for instance 1 mm from the plate 16.

[0040] The above mentioned sealing ring 18 of cellular rubber with closed cells can be used to additional advantage in a bass clarinet and like instruments to avoid the problem of "blowing bubbles".

[0041] The valve 15 of figure 16 has a frustoconical ring 93 of cellular rubber glued to plate 16 and glued in bush 94 with frustoconical guide edge. Plate 16 can swivel on the rounded lower end of core 92 of solid rubber or teflon, each of 40-80° Shore.

Claims

1. Wind instrument (1) comprising a basic body (2) in which extends a central duct bounded by a peripheral wall of the basic body (2), a plurality of openings (4) in the peripheral wall which connect the duct with the surrounding air, a number of valves (5) mounted on the basic body (2) and each comprising a closure member (15) co-acting with an opening (4) and comprising control means (6) connected to said valves (5), wherein said control means (6) guide said closure member (15) for movement between a closed position in which the opening (4) is closed by said closure member (15) and an open position in which the opening (4) is left clear, wherein the closure member (15) comprises a plate (16) of substantially stiff material which is provided on the side facing toward the opening (4) with sealing material (17) and in the closed position engages round the opening (4) and that the closure member (15) is connected to the control means (6) by yieldable means (22) and wherein the plate (16) of substantially stiff material is connected to a rod (21) of said control means by means of an engagement element (94) fixedly mounted on the rod (21) or forming part of said rod (21), **characterized in that** said engagement element extends from the centre of the plate (16) in diverse directions over only a fraction of the radius of the plate (16), for instance up to less than half said radius.
2. Wind instrument (1) as claimed in claim 1, **characterized in that** with playing finger keying force the yieldable means (22, 32, 49) provide the possibility of axial displacement of the closure member (15) relative to the control means (6), said displacement ensuring the sealing, and said yieldable means preferably comprise elastic material which is arranged between the closure member (15) on the one side and said engagement element on the other, which yieldable means (22) preferably comprise a layer of foam material which is arranged between the closure member (15) on the one side and the control means (6) on the other.
3. Wind instrument (1) as claimed in claim 1 or 2, **characterized in that** said yieldable means (22) comprises a core (92) of elastic material and a connection member (93), which connection member is made of flexible material and is constituted by a cushion (93) of elastic foam material surrounding said core (92) and being more flexible than said elastic material of said core (92).
4. Wind instrument (1) as claimed in claim 3, **characterized in that** the part of said cushion (93) being spaced the most from said substantially stiff plate (16) is enclosed by ring means (94) of said control means, said ring means (94) extending in the direction towards said plate (16).
5. Wind instrument (1) as claimed in any of the foregoing claims, **characterized in that** the closure member (15) is supported relative to said engagement element by means of a central elastic element surrounded by a connection member (93) preferably consisting of a ring of softer elastic material such as foam rubber or foam resin which connection member (93) permits tilting of said closure member.
6. Wind instrument (1) as claimed in any of the foregoing claims, **characterized in that** the closure member (15) is only connected in its centre to said engagement element.
7. Wind instrument (1) as claimed in any of the foregoing claims, **characterized in that** the sealing material consists of a thin layer of foam material, for instance cellular rubber, preferably with closed cells and having a thickness of the order of magnitude of 0.5 to 2 mm.
8. Wind instrument (1) as claimed in any of the foregoing claims, **characterized in that** the plate of substantially stiff material is flat.
9. Wind instrument (1) as claimed in any of the foregoing claims, **characterized in that** the plate of substantially stiff material has plate thicknesses of 0.1 to 1 mm.
10. Closure member (15) for a wind instrument (1) as claimed in any of the foregoing claims, **characterized in that** the closure member (15) comprises a plate (16) of substantially stiff material which is provided on the side to face toward the opening with sealing material (17) for sealingly engaging all round said opening (4) in the closed position, and that said closure member (15) is provided with yieldable means (22) for fixing to the control means (6) and wherein the plate (16) of substantially stiff material is connected to a rod (21) of said control means by means of an engagement element (94) fixedly mounted on the rod (21) or forming part of said rod (21), **characterized in that** said engagement element extends from the centre of the plate (16) in diverse directions over only a fraction of the radius of the plate (16), for instance up to less than half said radius.

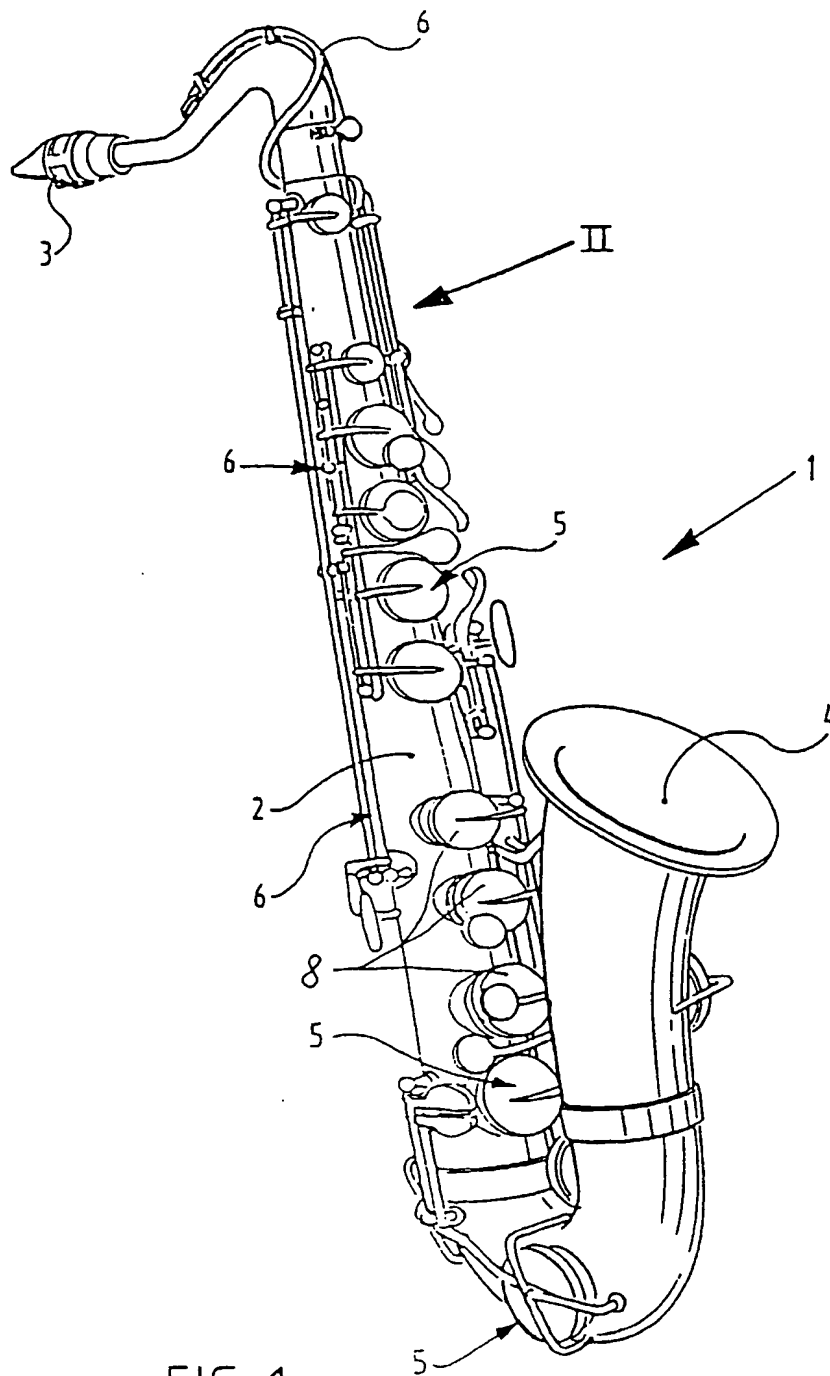
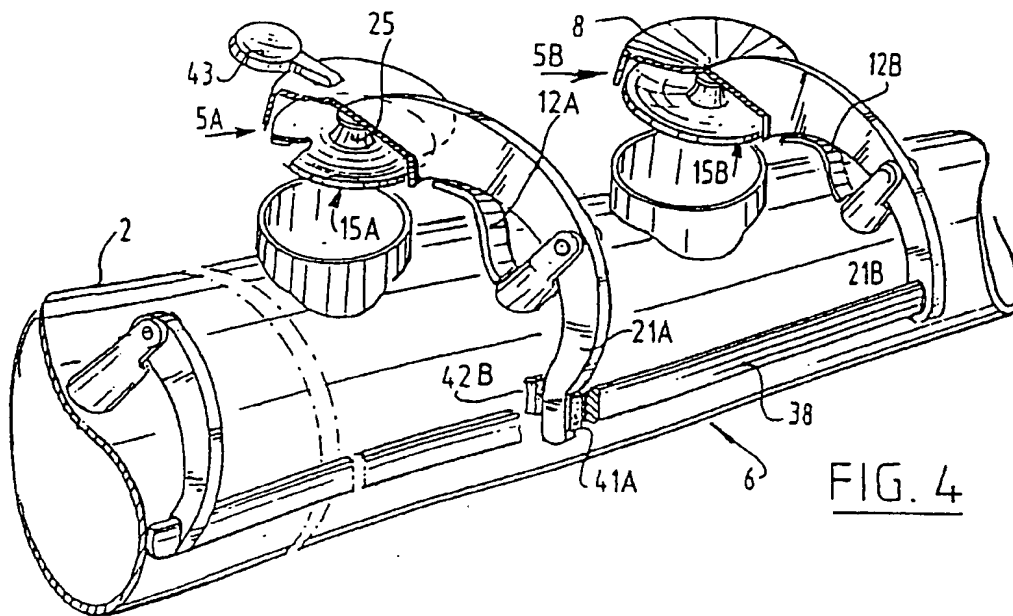
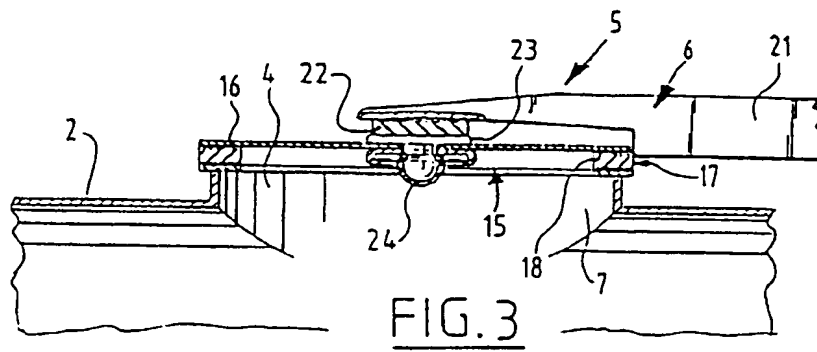
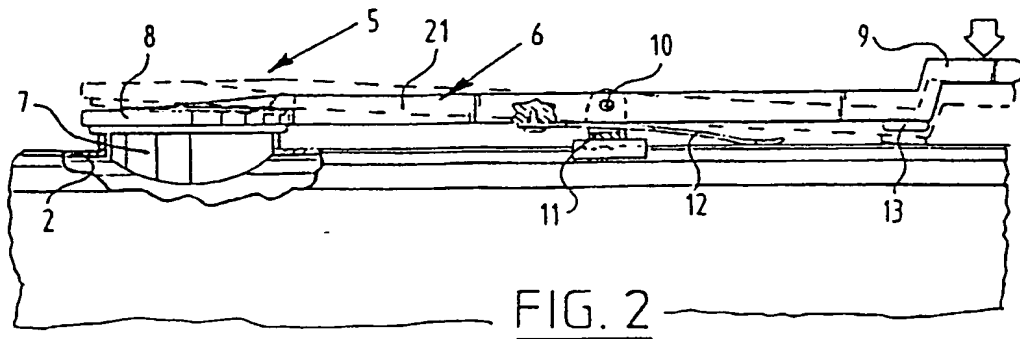
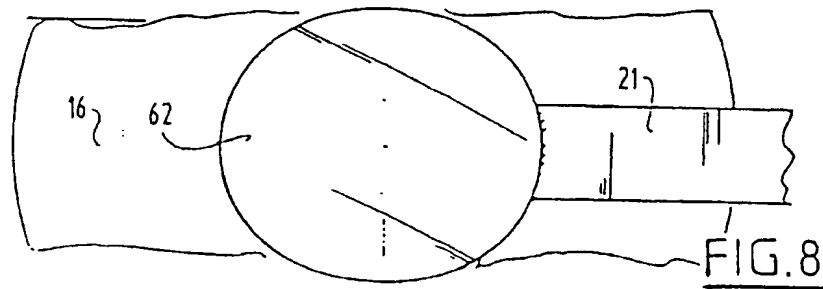
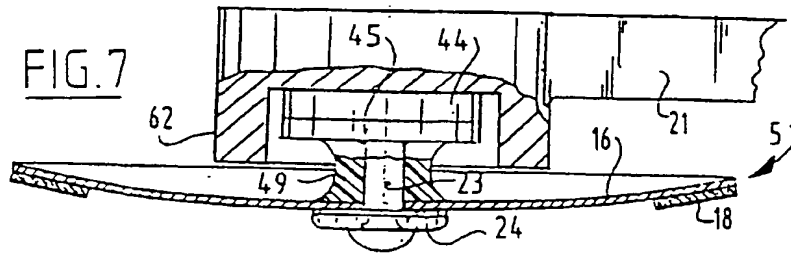
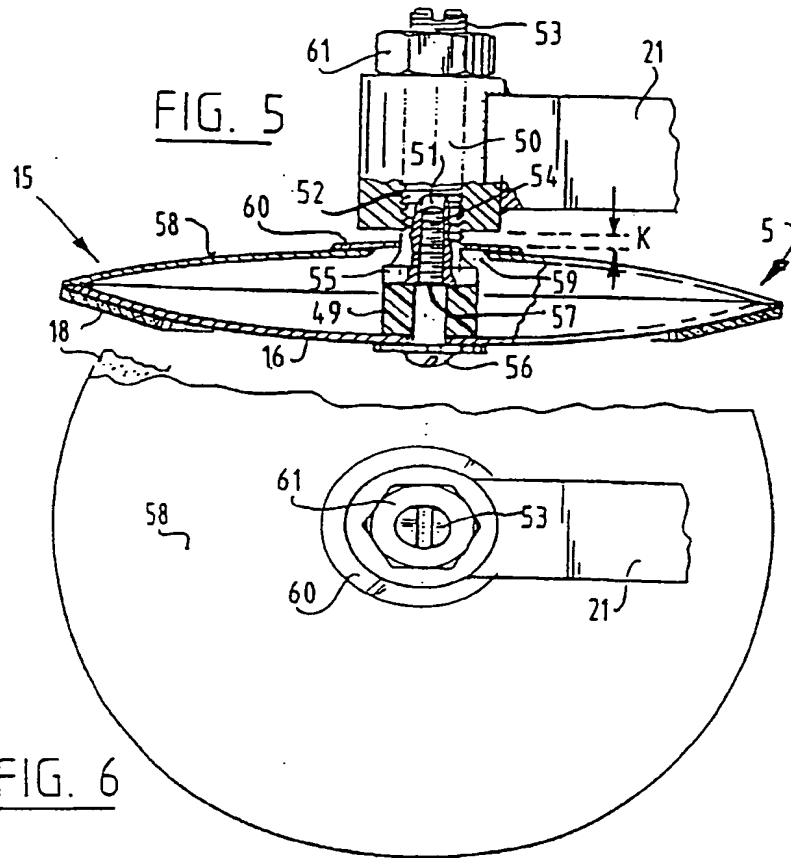
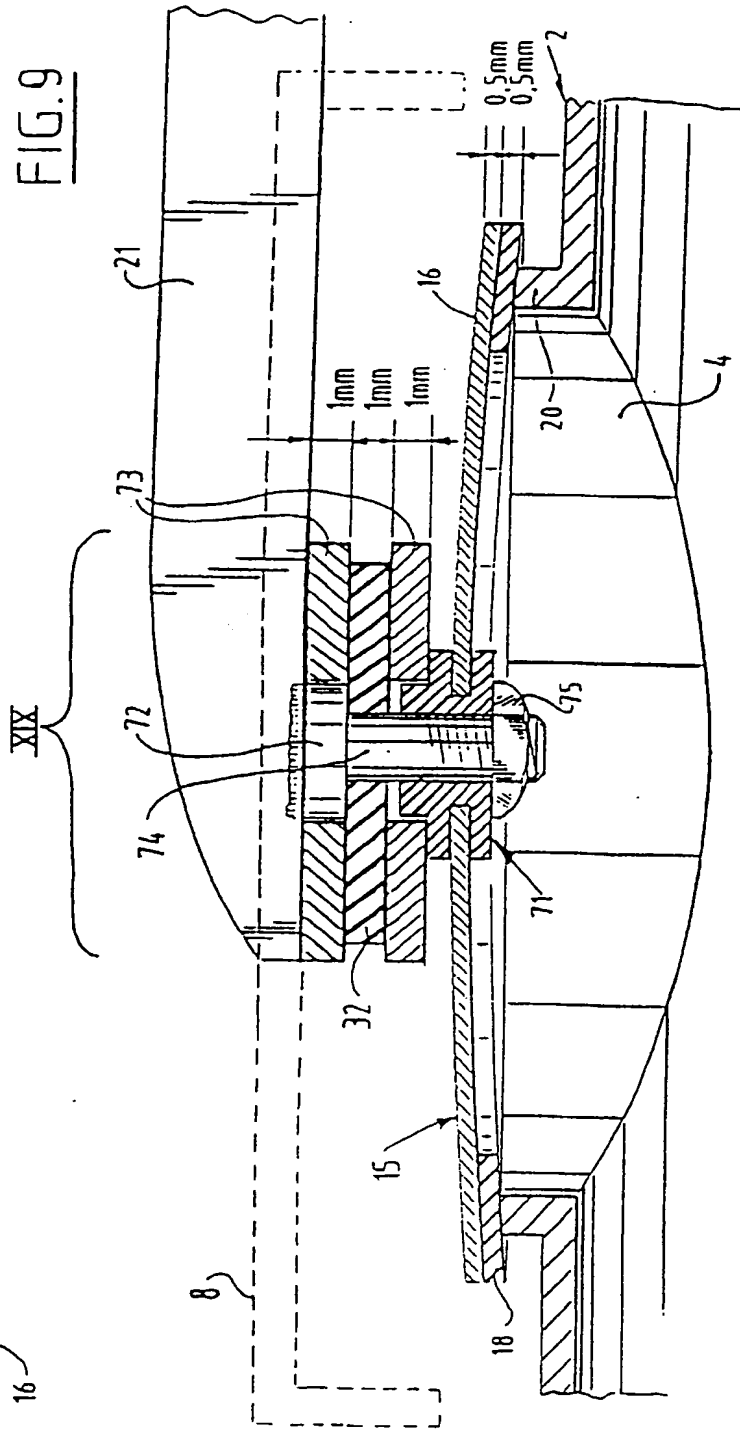
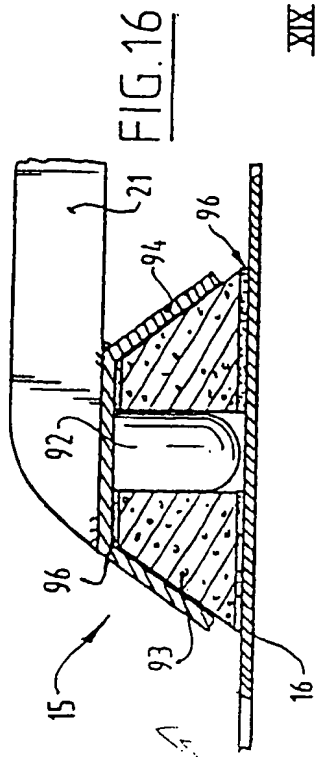


FIG. 1







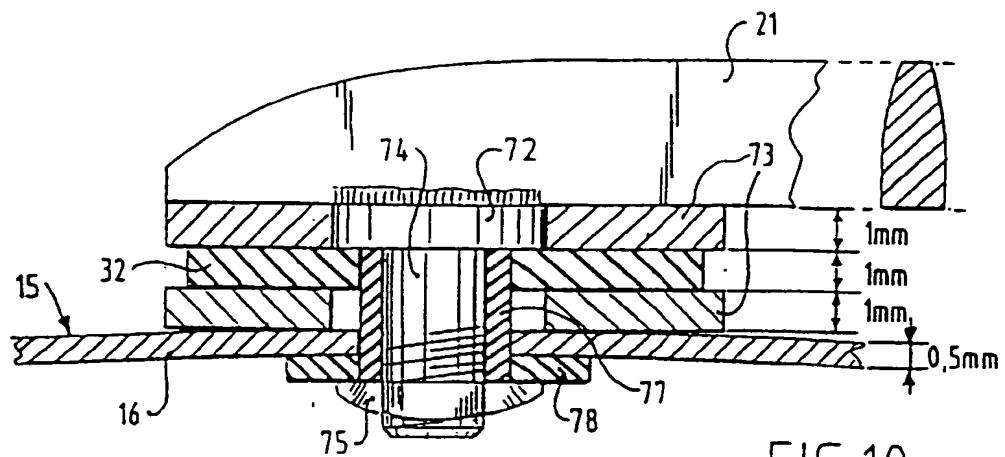


FIG. 10

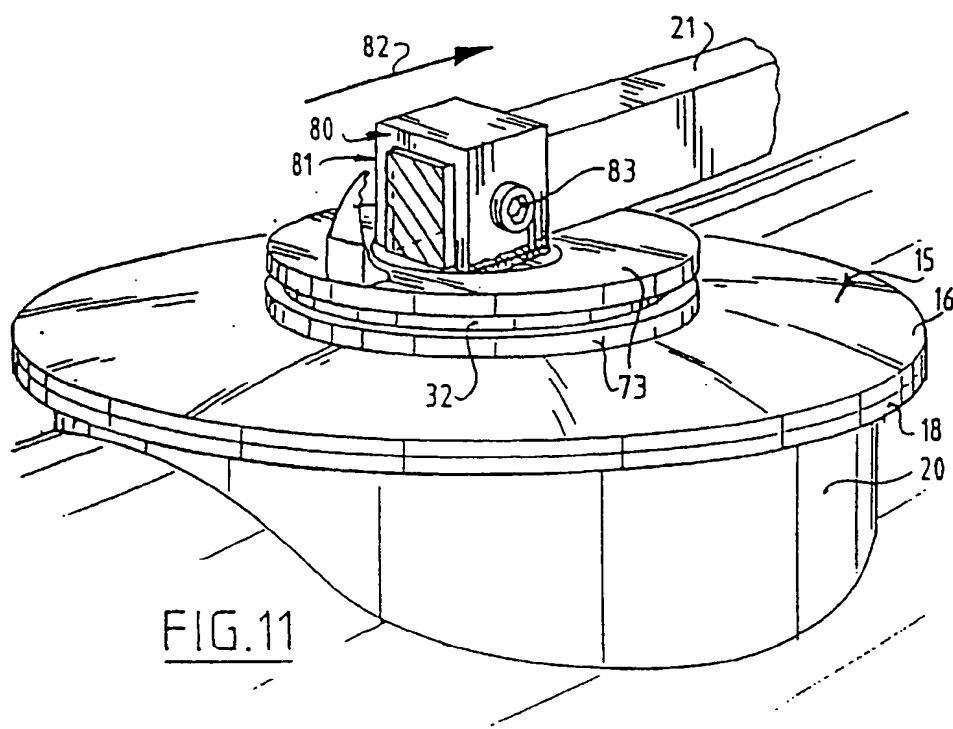
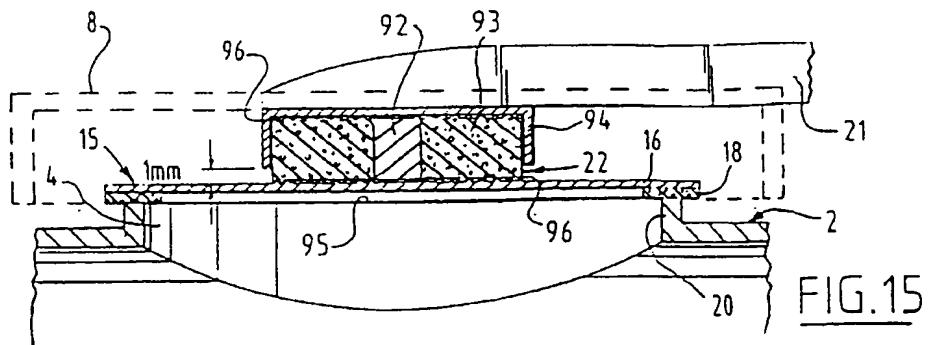
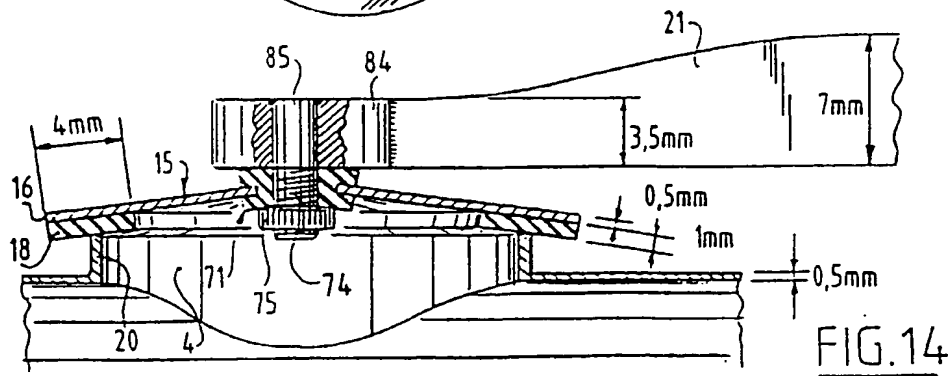
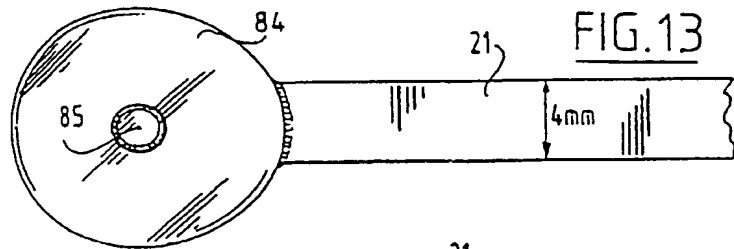
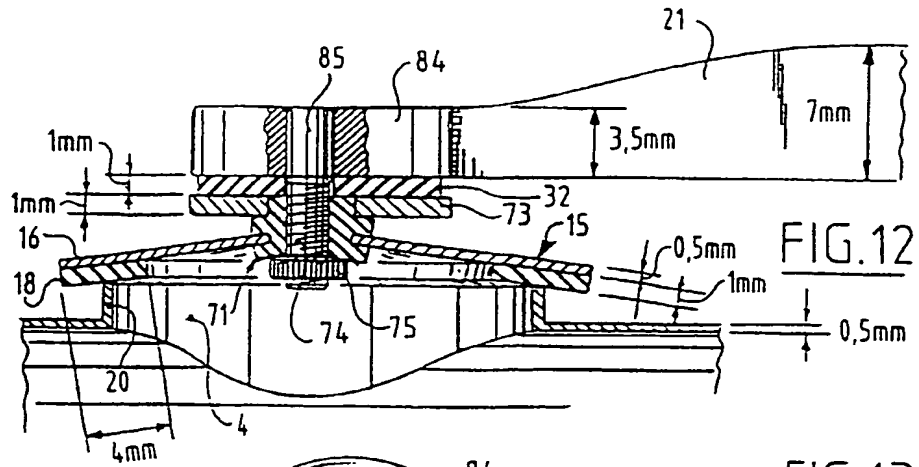


FIG. 11





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EUROPEAN SEARCH REPORT

Application Number
EP 98 20 3964

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19 January 1999	Examiner de Heering, Ph.
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EPO FORM 1503 (03/87) (Pct-01)

ANNEX TO THE EUROPEAN SEARCH REPORT
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